NRC FORM 366 (6-89) | U.S. NUCLEAR REGULATORY COMMISSION

LICENSEE EVENT REPORT (LER)

APPROVED OMB NO. 3150-0104
EXPIRES: 4/30/92
ESTIMATED BURDEN PER RESPONSE TO COMPLY WITH THIS INFORMATION COLLECTION REQUEST: 50.0 HRS. FORWARD COMMENTS REGARDING BURDEN ESTIMATE TO THE RECORDS AND REPORTS MANAGEMENT BRANCH (P-530), U.S. NUCLEAR REGULATORY COMMISSION, WASHINGTON, DC 20555, AND TO THE PAPERWORK REDUCTION PROJECT (3150-0104), OFFICE OF MANAGEMENT AND BUDGET, WASHINGTON, DC 20503.

FACILITY NAME (1)	DOCKET NUMBER (2)	PAGE (3)
Perry Nuclear Power Plant, Unit 1	0 5 0 0 0 4 4 0	1 OF 0 3

TITLE (4) Recirculation System Flow Transient Due to Solenoid Valve Failure Results in Thermal Power Level Exceeding the Operating License Requirements

EVENT DATE (5)			LER NUMBER (6)					REPORT DATE (7)			OTHER FACILITIES INVOLVED (8)	
MONTH	DAY	YEAR	YEAR		SEQUENTIAL NUMBER		REVISION NUMBER	MONTH	DAY	YEAR	FACILITY NAMES	DOCKET NUMBER(S)
												0 5 0 0 0
0 9	1 3	8 9	8 9	–	0 2 6	–	0 0	1 0	1 3	8 9		0 5 0 0 0

OPERATING MODE (9)	1	THIS REPORT IS SUBMITTED PURSUANT TO THE REQUIREMENTS OF 10 CFR §: (Check one or more of the following) (11)			
POWER LEVEL (10)	1 0 0	20.402(b)	20.405(c)	50.73(a)(2)(iv)	73.71(b)
		20.405(a)(1)(i)	50.36(c)(1)	50.73(a)(2)(v)	73.71(c)
		20.405(a)(1)(ii)	50.36(c)(2)	50.73(a)(2)(vii)	X OTHER (Specify in Abstract below and in Text, NRC Form 366A)
		20.405(a)(1)(iii)	50.73(a)(2)(i)	50.73(a)(2)(viii)(A)	
		20.405(a)(1)(iv)	50.73(a)(2)(ii)	50.73(a)(2)(viii)(B)	License Violation
		20.405(a)(1)(v)	50.73(a)(2)(iii)	50.73(a)(2)(x)	

LICENSEE CONTACT FOR THIS LER (12)

NAME	TELEPHONE NUMBER
Gregory A. Dunn, Compliance Engineer, Extension 6484	AREA CODE 2 1 6 2 5 9 – 3 7 3 7

COMPLETE ONE LINE FOR EACH COMPONENT FAILURE DESCRIBED IN THIS REPORT (13)

CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS		CAUSE	SYSTEM	COMPONENT	MANUFACTURER	REPORTABLE TO NPRDS	
X	A D	S O L	X 9 9 9	N							

SUPPLEMENTAL REPORT EXPECTED (14)		EXPECTED SUBMISSION DATE (15)	MONTH	DAY	YEAR
YES (If yes, complete EXPECTED SUBMISSION DATE)	X NO				

ABSTRACT (Limit to 1400 spaces, i.e., approximately fifteen single-space typewritten lines) (16)

On September 13, 1989 at 1636 reactor thermal power level exceeded that specified in the Operating License due to an unexpected Recirculation System Flow Control transient. Prior to the event the plant was in Operational Condition 1 (Power Operation) at 100 percent of rated power. Operators recovered from the transient by inserting control rods and adjusting recirculation loop flow in accordance with approved plant instructions. The total duration power exceeded 100 percent was approximately 2 minutes and 10 seconds.

The cause of this event was a component failure. Failure of a solenoid valve in the Hydraulic Power Unit caused the Flow Control Valve to stroke from 56 percent to a final position of 89 percent open. Subsequent troubleshooting found a varnish-type material on the plunger internal to the isolation solenoid valve. This material is believed to have caused the valve to fail in midposition allowing oil to pass to the Flow Control Valve actuator.

To prevent recurrence the failed isolation solenoid valve has been replaced. Another isolation solenoid will be disassembled and inspected. Based on the inspection results, the need to replace the remaining solenoid valves and the frequency and necessity of a periodic replacement of these valves will be evaluated.

On September 13, 1989 at 1636 reactor thermal power level exceeded that specified in the Operating License due to an unexpected Recirculation System [AD] Flow Control transient. At the time of the event, the plant was in Operational Condition 1 (Power Operation) with reactor thermal power approximately 100 percent of rated. Reactor vessel [RPV] pressure was approximately 1000 psig with reactor coolant at saturated conditions.

At 1617, on September 13, 1989, Hydraulic Power Units (HPU)s for the Recirculation System Flow Control Valves [FCV] were shut down in order to perform tuning on the Recirculation Flow Control circuitry. At 1636, with the maintenance complete, HPU A subloop 1 on FCV A was started. Operators immediately noted an increase in reactor power and identified that FCV A had started to stroke open. Power on the control room panel read 105 percent and the Automatic Flow Demand Limitor (AFDL) alarm [FA] was received. At 1637 the operator took actions in accordance with the approved instructions, including an emergency shutdown of HPU A to stop valve movement and insertion of control rods to reduce power to 90 percent. Flow in recirculation Loop B was then adjusted to match flow in Loop A, ensuring compliance with Technical Specifications. At 1912 FCV A operability was restored by starting Subloop 2 of the HPU. Restoration of the alternate subloop was hindered due to being out-of-service to replace breaker overloads. By 2152, control rod patterns and recirculation flow were restored to pre-transient conditions.

The cause of this event was a component failure. Each Flow Control Valve has a HPU with two associated subloops. The HPU contains an oil reservoir [RVR] to supply oil to the FCV actuator through servo control valves (one for each subloop) which reposition as demanded by the FCV logic. Hydraulic oil is then directed to the FCV actuator causing the valve to reposition. HPU logic is designed to prevent motion of its FCV under certain circumstances by using solenoid [SOL] isolation valves to place a hydraulic lock on the system. In this event, the solenoid isolation valve failed to fully isolate the valve actuator from the HPU. When subloop 1 of HPU A was restarted, oil was directed past the partially opened isolation solenoid valve, and was directed to the FCV A actuator through servo valves which has repositioned in response to a demand signal present at that time. This caused FCV A to reposition from 56 percent to 89 percent. Disassembly of the solenoid valve identified a varnish-type material on the plunger internal to the valve. It is believed this material caused the plunger to stick in mid position, causing the solenoid coil [CL] to burn up and the fuse to blow. The varnish-like material is suspected to be degraded lubricant from spring coils internal to the valve. The valve is a Sperry-Vickers model F3-DG4S-4-016C-120/60-50.

A previous experience on August 8, 1989 where FCV A stroked open following an HPU startup also identified the isolation solenoid as the failed component. The corrective actions in that case were to clean the solenoid plunger, and to the replace the solenoid coil and the blown fuse. All these actions were performed external to the valve body after an evaluation by the responsible system engineer and maintenance personnel. Although this corrective action was considered to be

adequate at the time, failure to completely replace or disassemble the valve was a contributing factor in the September 13 event. The individuals involved were made aware of this during the investigation of the cause of this event.

Recirculation Flow Control Failure With Increasing Flow is analyzed in the Updated Safety Analysis Report (USAR) Section 15.4.5. This analysis assumes a 30 percent per second flow control valve rate of travel from an initial flow condition of 33 percent rated flow, resulting in a reactor scram on high neutron flux at 118 percent. During the event of September 13, the flow control valve opened at less than one percent per second, from an initial flow of approximately 90 percent. Maximum neutron flux achieved was recorded at approximately 107 percent. This event, therefore, was fully within the envelope of the analysis in the Safety Analysis Report. All plant systems functioned as designed and all operator actions were taken in accordance with approved operating instructions. Power remained over 102 percent thermal power for less than 2 minutes, and over 100 percent for approximately 2 minutes and 10 seconds. In addition thermal limits, as calculated by reactor engineering, were not challenged at any time during this transient. If the failure of the isolation solenoid had resulted in FCV A stroking closed, the core flow would have been reduced to approximately 65 percent. This flow is well above the instability region, therefore this event is not considered to be safety significant.

On June 16, 1988, reactor power also exceeded 100 percent due to a Recirculation Flow Control Failure With Increasing Flow, and in that case resulted in a reactor SCRAM(LER 88-024). This was attributed a noise spike during reinsertion of the automatic flux control card into the recirculation flow control circuitry. The corrective actions included locking up the HPU to the FCVs prior to maintenance on electronic circuit boards in the recirculation flow control system during power operation. This procedure was followed prior to the transient on September 13 and did not contribute to the incident; it was after the HPU was restarted that the transient occurred. Therefore, the corrective action for LER 88-024 are considered to have been adequate.

In order to prevent recurrence, the following steps are being initiated:

1. The failed isolation solenoid valve on subloop 1 has been replaced and disassembled for determination of the cause/potential impact to other valves. During similar maintenance on the FCV B loop, when both HPUs were locked up, all isolation soleroid valves operated satisfactorily.

2. Another isolation solenoid will be disassembled and inspected. Based on the inspection results, the need to replace the remaining solenoid valves and the frequency and necessity of a periodic replacement of these valves will be evaluated.

Energy Industry Identification System Codes are identified in the text as [XX].